Beckman Industrial™

An Affiliate of Emerson Electric Co.

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CAPT6

Capacitance and Parts Tester

Operator's Manual

ONE YEAR LIMITED WARRANTY

Beckman Industrial's Model CAPT6 is warranted against defects in parts, material and workmanship for a period of one (1) year following the date of purchase of the parts test meter by the original buyer. This warranty is extended by Beckman Industrial only to the original buyer or original user of the instrument who must present proof of purchase at time of warranty service.

Any implied warranties arising out of the sale of Model CAPT6, including but not limited to implied warranties of merchantability and fitness for a particular purpose, are limited in duration to the above stated one (1) year period. Manufacturer shall not be liable for loss of use of the parts test meter or other incidental or consequential damages, expenses or economic loss.

Some states do not allow limitations on how long implied warranties last or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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CERTIFICATION

Beckman Industrial certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when shipped from the factory.

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WARNINGS AND PRECAUTIONS

Please read section 2.1 and 2.2. WARNINGS AND PRECAUTIONS

Even low-level voltages and currents can potentially cause serious injury or even death from electrical shock. Please do not use this or any piece of test equipment without proper training.

SECTION ONE: INTRODUCTION

1.1 Unpacking and Inspection

Upon removing your new Capacitor And Parts Tester (CAPT6) from its packing materials, you should have the following items:

1. CAPT6
2. Test Lead Set (1 black, 1 red)
3. 9-Volt Battery (in CAPT6)
4. Warranty Card
5. Operators Manual
6. Two Fuses (one spare, one in CAPT6)

Please inspect each item carefully. If any of the items are missing, or have been received in a damaged condition, return the entire package to the distributor from whom the unit was purchased. Please contact Beckman Industrial at(619) 495-3200if the distributor is unable to provide the desired assistance.

1.2 Familiarization

Please refer to the drawing of CAPT6 on the adjacent page for the following explanations of controls and connections:

1 LCD DISPLAY . . . . . This is where the reading associated with the measurement being made is shown.

2 CAP. ZERO ADJUST . . . . . Used to null out small values of stray capacitance.

3 FUNCTION/RANGE SWITCH . . Selects measurement type and range (where applicable).

4 CAP COMMON (1) . . . . . Common (negative) jack for small capacitors.

5 CAP HIGH (1) . . . . . High (positive) jack for small capacitors.

NOTE: All four small holes on the Common jack are connected in parallel. Likewise, all four on the positive jack are connected in parallel.

6 CAP HIGH (2) . . . . . High (positive) banana jack for large caps requiring the use of test leads.

7 CAP COMMON (2). . . . . Common (negative) banana jack for large caps requiring the use of test leads.

8 MEASUREMENT HIGH . . . . . High (positive) banana jack for all measurement usage excluding capacitance and transistor measurements.

9 MEASUREMENT COMMON. . . Low (negative) banana jack for all measurement usage excluding capacitance and transistor measurements.

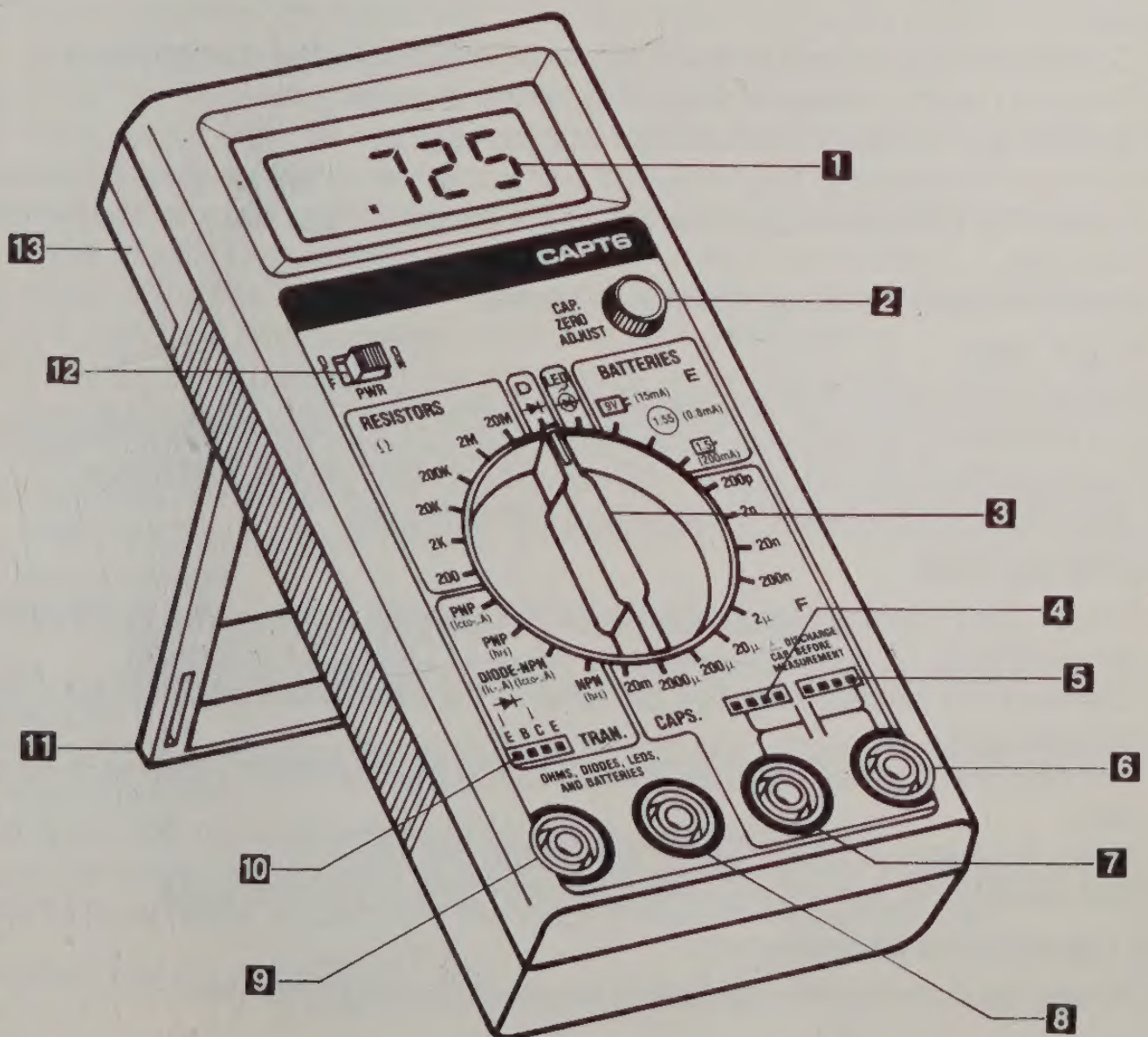
10 TRANSISTOR JACK . . . . . Used for all transistor hFE and ICEO measurements. Leads inserted per legend.

11 TILT BAIL . . . . . Used to support the unit when used on bench-top for easy readability of the display.

12 POWER SWITCH . . . . . Main power switch. Turn off when not in use to conserve battery life.

13 BATTERY COVER. . . . . Access cover for battery and fuse replacement.

NOTE: RANGE OVERLOAD IS INDICATED BY A "1" OR A "–1" SHOWN IN THE DISPLAY WITH ALL OTHER DIGITS BLANKED. WHEN IN THIS CONDITION, THE USER SHOULD TAKE IMMEDIATE STEPS TO REMOVE THE CAUSE OF THE OVERLOAD CONDITION FROM THE UNIT.



SECTION TWO: OPERATION

2.1 Warnings

Since injury or death can occur even with low voltages, exercise caution when using this or any other piece of electronic test equipment. Please do not use this or any test equipment without proper training.

2.2 Safety Precautions

1. Exceeding the maximum overload limits can damage the unit.
2. Use only mild detergent and warm water to clean the unit. Do not use aromatic hydrocarbons or chlorinated solvent for cleaning.

2.3 Diode Tests

1. Rotate the Function/Range Switch to the diode (D) position.
2. Connect the diode cathode to the Measurement Common (black) banana jack.
3. Connect the diode anode to the Measurement High (red) banana jack.
4. Read the diode forward voltage drop in the display.
5. Disconnect the diode from the banana jacks.
6. Connect the diode to the Transistor Test socket as shown on the front panel.
7. Rotate the Function/Range Switch to the Diode NPN position in the transistor test area.
8. Read the diode leakage current in display.

2.4 LED Tests

1. Rotate the Function/Range Switch to the LED position.
2. Connect the LED cathode to the Measurement Common (black) banana jack.
3. Connect the LED anode to the Measurement High (red) banana jack.
4. Read the LED's forward voltage drop in the display.

2.5 Battery Tests

1. Rotate the Function/Range Switch to the desired battery type in the battery range (9-volt, 1.5 volt button-type, or AA, C or D-type 1.5 volt cells).
2. Connect the battery negative terminal to the Measurement Common (black) banana jack.
3. Connect the battery positive terminal to the Measurement High (red) banana jack.
4. Read the battery voltage under load in the display.
5. Disconnect the battery from the CAPT6 to avoid total discharge.

2.6 Capacitance Measurement

1. Rotate the Function/Range Switch to select the 200pF range.

2. If they will be used in the measurement, plug the red and the black test leads into the red and the black capacitor test jacks, respectively.
3. *With the test capacitor disconnected,* use the Cap. Zero Adjust control to adjust the display for a zero reading.
4. Verify that the test capacitor is fully discharged. Then, observing proper polarity, connect the capacitor to be measured to either set of capacitor test jacks.
5. If an overrange indication is shown in the display, select the lowest capacitance range that produces a reading.
6. Read the capacitor value in the display.

NOTE:

1. Never apply voltage to the capacitor test jacks. Serious damage to the instrument may result.
2. Never short the capacitor test jacks together, as this will cause high power dissipation and will discharge the battery in an extremely short period.
3. A shorted capacitor will read overrange on all ranges.
4. A capacitor with low-voltage leakage will read overrange, or a much higher than normal value.
5. Measuring small capacitances should be done with very short test leads, in order to avoid introducing stray capacitances in the reading.
6. When using the test leads to take a measurement, remember that the leads will introduce a measurable capacitance into the reading.
7. Electrolytic capacitors have notoriously wide tolerances. It is not uncommon for one to have up to twice the capacitance marked on the unit. However, values are seldom drastically below the marked value.
8. Leakage in a capacitor is indicated if the displayed value changes significantly as ranges are changed. This effect is minimum on the lower capacitance ranges.

LARGE CAPACITANCE (> 20,000 μF) TEST METHOD:

1. Select a known-value capacitor with a capacitance as close to 20,000 μF as possible.
2. Connect the capacitor to be tested (value> 20,000 μF) in series with the known-value capacitor.
3. Measure the total capacitance of the series capacitor pair.
4. Use the value of the known capacitor (Ck) and the series capacitance (Cs) in the formula below to calculate the value of the test capacitor (Cx).

FORMULA: $Cx = \frac{(Ck)(Cs)}{(Ck-Cs)}$

2.7 Transistor Measurement

2.7.1 hFE (DC Current Gain)

1. Rotate the Function/Range Switch to the NPN or the PNP hFE position, depending on which type of transistor is to be tested.
2. Plug the transistor to be tested into the Transistor Test Socket, being sure to observe proper lead connection as shown on the front of the instrument.
3. Read the hFE value in the display.

2.7.2 Iceo (Leakage)

1. Rotate the Function/Range Switch to the NPN or the PNP Iceo position, depending on which type of transistor is to be tested.
2. Plug the transistor to be tested into the Transistor Test Socket, being sure to observe proper lead connection as shown on the front of the instrument.
3. Read the Iceo value in the display.

2.8 Resistor Measurement

1. Rotate the Function/Range Switch to the range in the Resistor section appropriate to measure the resistor to be tested. If the resistor value is unknown, use the 200 ohm range.
2. Plug the red and the black test leads into the red and the black Measurement jack, respectively.
3. Connect the resistor to be measured to the test leads and read the resistance value in the display. If an overrange indication is present, select the next higher range until a reading is obtained.

SECTION THREE: OPERATOR MAINTENANCE

3.1 Troubleshooting

If there appears to be a malfunction during use of the instrument, the following steps should be followed in order to isolate the cause of the problem:

1. Check the battery.
2. Review the operating instructions for possible mistakes in operation.
3. Inspect and test the test leads for a broken or intermittent condition.
4. Inspect and test the fuse. If replacement is indicated, replace it only with one of the same type and rating to preserve protection.
5. If steps (1) through (4) fail to correct the problem, either contact an Authorized Service Center for assistance in correcting the problem or, refer to Section 6.4 for a complete troubleshooting guide.

NOTE: ATTEMPTED REPAIR OR MODIFICATION BY UNAUTHORIZED PERSONS WILL VOID THE LIMITED WARRANTY.

3.2 Battery or Fuse Replacement

WARNING:

To prevent electrical shock hazard, turn off the instrument and remove the test leads before removing the battery hatch or the rear cover.

3.2.1 Battery Replacement

1. Remove the screw located near the battery cover. Remove the battery cover by removing the locking screw and gently slideing it towards the top of the instrument with both thumbs.
2. Remove and disconnect the old battery from the instrument and replace with a new unit. Wind the excess battery lead length once around the battery clip, install the battery, and replace the battery cover. Retighten battery door screw

3.2.2 Fuse Replacement

1. Remove the screw located near the battery cover. Remove the battery cover by gently sliding it towards the top of the instrument with both thumbs.
2. Remove the old fuse and replace with a new 100 mA 250 volt fuse. Retighten battery door screw.

3.3 Calibration Procedures

3.3.1 Capacitance Calibration

1. Remove the battery hatch as previously described.
2. Remove the two screws that secure the back cover to the front cover. These are located under the tilt bail.
3. Carefully remove the back cover of the instrument by gently pulling it away from the front case.
4. Plug the test leads into the capacitor banana jacks and place them close together. Do not, however, connect them to a capacitor or to each other.
5. Rotate the Function/Range Switch to the 200pF range. Now use the Cap Zero Adjust control to obtain a reading of zero in the display.
6. Connect a standard capacitor to the test leads. The capacitors value should be near the full scale value of one of the highest ranges, and its value should be known within +/− 0.1% accuracy.
7. Adjust potentiometer R29 for a display reading equal to the value of the standard capacitor.
8. Disconnect the standard capacitor, and reinstall the rear cover and the battery hatch.

3.3.2 LED, Battery, hFE, Diode and Resistor Calibration

1. Remove the battery hatch as previously described.
2. Remove the two screws that secure the back cover to the front cover. These are located under the tilt bail.
3. Carefully remove the back cover of the instrument by gently pulling it away from the front case.
4. With nothing connected to the Measurement jacks of the instrument, rotate the Function/Range Switch to the LED position.
5. Connect a digital voltmeter with an accuracy of at least 0.1% between the Measurement common jack and the positive terminal of the 9-volt battery.
6. Adjust potentiometer R45 for a reading in the CAPT6 display that is the same as the reading in the DVM display.
7. Disconnect the DVM, and reinstall the rear cover and the battery hatch

SECTION FOUR: SERVICE

4.1 Warranty Information

In the United States and Canada, the limited warranty period is one year. Please refer to the warranty statement on the inside front cover for warranty details. For further information, or for warranty information outside the U.S. and Canada, please contact:

U.S./CANADA

Beckman Industrial Corporation
630 Puente Street
Brea, CA 92621 U.S.A.
(714) 671-4831

EUROPE

Beckman Industrial Corporation
550 S. Harbor Blvd.
La Habra, CA 90631 U.S.A.
(213) 690-7255

4.2 Warranty Repair

Any CAPT6 Capacitor And Parts Tester thought to be defective while still covered under warranty should be returned to Beckman Industrial Corp. with a $3.00 handling fee within the U.S., or $12.00 from Canada (In Europe, please contact the Scotland address given above for warranty repair information). NOTE: Warranty handling charge subject to change without notice.

4.3 Nonwarranty Repair

Any out-of-warranty CAPT6 that is defective but repairable, may be repaired by any Authorized Service Center or by Beckman Industrial. The repaired unit carries a one (1) month warranty. Inside the U.S., the flat-rate factory repair charge is $30.00 if payment is included with the instrument, or $35.00 if payment must be billed. In Canada, please contact any Authorized Repair Center for out-of-warranty repair charges. In Europe, contact the Scotland address given above for out-of-warranty repair information.

4.4 Shipping Instructions

CAPT6's returned for repair or for calibration must be accompanied with the following information or items: Company name (if applicable), users name, mailing/shipping address, telephone number, proof-of-purchase (for in-warranty repairs), a brief description of the problem or the service requested, and the appropriate service charge.

Service charges should be remitted in the form of a check, money order, or purchase order (please do not send cash) made payable to Beckman Industrial Corporation.

The instrument should be shipped with transportation charges prepaid (we will not accept COD shipments) to the following address:

Beckman Industrial Corporation
550 S. Harbor Blvd.
La Habra, CA 90631 U.S.A.
(213) 690-7255
ATTN: Instrument Repair Department

The instrument will be returned after repair with the transportation charges paid by Beckman Industrial.

SECTION FIVE: SPECIFICATIONS

5.1 General Specifications

Temperature Range	
Specified Accuracy	18°C to 28°C (64°F to 82°F)
Useable Range (lower accuracy)	0°C to 50°C (32°F to 122°F)
Storage Range	−20°C to 60°C (−31°F to 140°F)
Relative Humidity	80% Max. (70% Max. for 20M)
Temperature Coefficient	Less than 0.15 times the applicable accuracy spec for 0°C to 18°C (32°F to 64.4°F) and 28°C to 50°C (82.4°F to 122°F)
Calibration Cycle	One year
Measurement Method	Dual-Slope Integration
Battery Type	9-Volt transistor cell
Battery Life	
Alkaline Cell	200 hours typical
Carbon-Zinc Cell	150 hours typical
Low-Battery Indication	"Lo Batt" displayed at 20% remaining battery life
Display Type	3½ digit, 0.5 inch LCD
Dimensions	
Height	160 mm (6.3 inches)
Width	76 mm (3 inches)
Thickness	35 mm (1.4 inches)
Weight	250 grams (8.8 oz.) including battery

5.2 Electrical Specifications

5.2.1 Diode Test

Open Circuit Voltage	3.2 volts maximum
Short Circuit Current	1.5 mA maximum
Display	Approximate forward voltage

5.2.2 LED Test

Open Circuit Voltage	3.2 volts maximum
Short Circuit Current	10 mA maximum
Display	Approximate foward voltage

5.2.4 Battery Test

9-Volt Battery Load	15 mA (approximate)
1.5-Volt AA, C, or D Cell Load	200 mA (approximate)
1.55-Volt Button Cell Load	0.8 mA (approximate)
Display	Loaded cell voltage

5.2.5 Capacitance Test

Range	*Accuracy*
200pF	0.5% rdg +1 dgt +0.5 pF
2nF to 200μF	0.5% reading +1 digit
2000μF	1% reading +1 digit
20mF (20,000μF)	1.5% reading +1 digit
Resolution	0.1pF (200pF range)
Test Voltage	3.2 volts maximum (peak)
Input Protection	100 mA, 250V fuse
Zero Adjustment	+/−20pF, minimum

5.2.5 Transistor Measurement

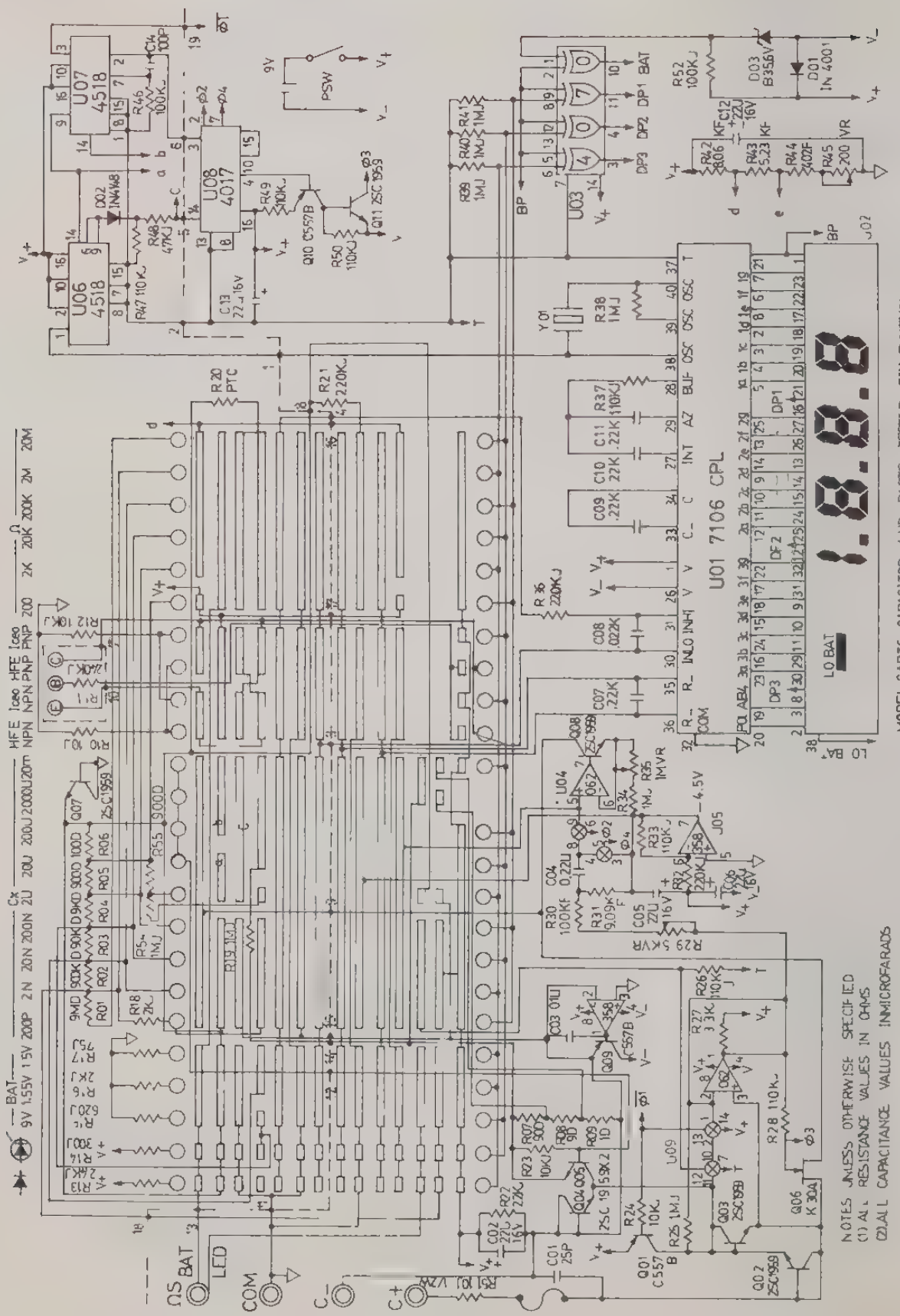
hFE Range	0-1000 (approximate)
hFE Base Current	10μA (approximate)
hFE Vce	3 volts (approximate)
Iceo (Leakage) Range	10nA to 20μA

5.2.6 Resistor Measurement

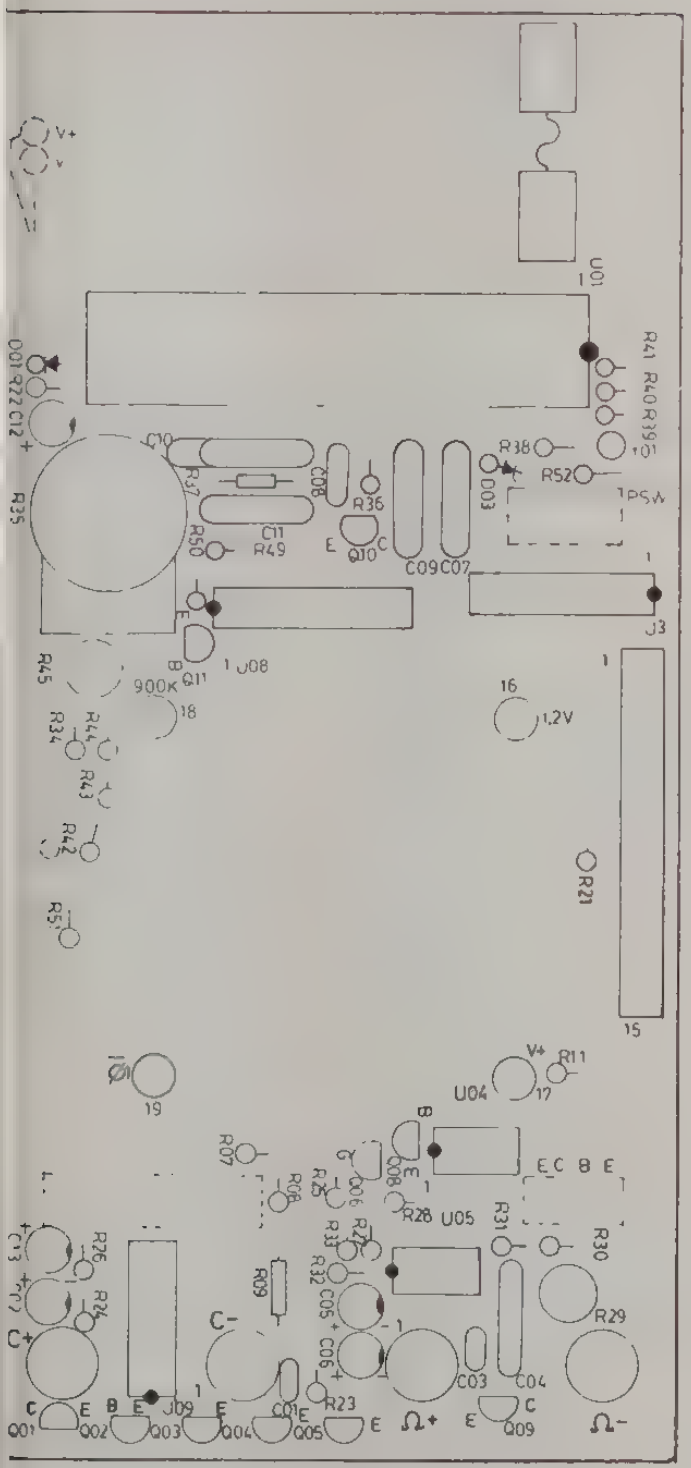
Range	*Accuracy*
200	0.5% reading +2 digits
2K to 2M	0.5% reading +1 digit
20M	2% reading +1 digit
Overload Protection	500VDC/AC RMS
Open Circuit Voltage	
200 Range	3.2 volts maximum
Other Ranges	1.5 volts maximum

SECTION SIX: TECHNICAL INFORMATION

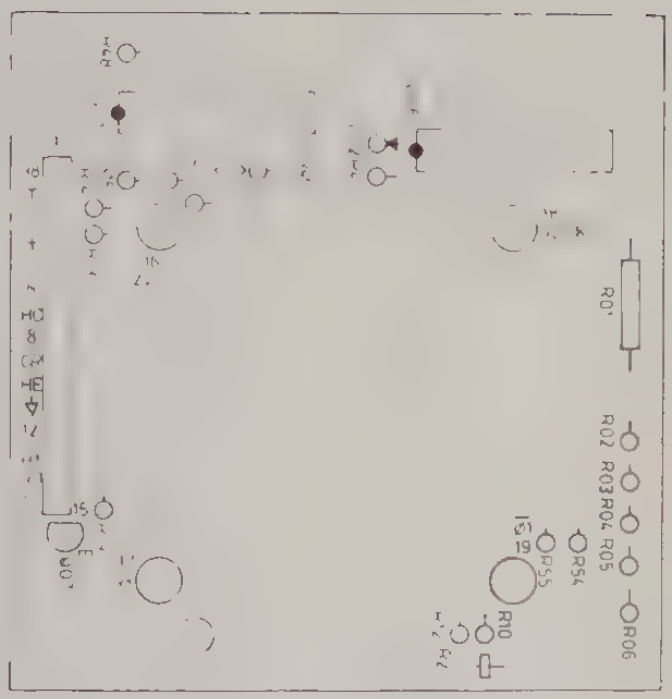
6.1 Schematic


U01 7106 CPL
LO BAT
MODEL CAP16 CAPACITOR AND PARTS TESTER SIX FUNCTION CIRCUIT DIAGRAM
NOTES UNLESS OTHERWISE SPECIFIED
(1) ALL RESISTANCE VALUES IN OHMS
(2) ALL CAPACITANCE VALUES IN MICROFARADS

6.2 Component Layout



Main P.C.B. Component
Side View



Daughter P.C.B. Component
Side View

6.3 Parts List

Ref. Desio.	Description	Quantity	Part Number
R10	10 ohm, 5%, ¼ watt	1	FG3002-020-10(
R12, 23, 24	10K, 5%, ¼ watt	3	FG3002-010-10
R46, 52	100K, 5%, ¼ watt	2	FG3002-010-10
R19, 25, 34, 38-41, 54	1Megohm, 5%, ¼ watt	8	FG3002-010-10
R26, 28, 33, 37, 47, 49, 50	110K, 5%, ¼ watt	7	FG3002-010-11
R16, 18	2K, 5%, ¼ watt	2	FG3002-020-20
R22	22K, 5%, ¼ watt	1	FG3002-020-22
R21, 32, 36	220K, 5%, ¼ watt	3	FG3002-020-22
R13	2.4K, 5%, ¼ watt	1	FG3002-020-24
R11	240K, 5%, ¼ watt	1	FG3002-010-244
R14	300 ohm, 5%, ¼ watt	1	FG3002-020-301
R27	3.3K, 5%, ¼ watt	1	FG3002-020-33
R48	47K, 5%, ¼ watt	1	FG3002-010-473
R15	620 ohm, 5%, ¼ watt	1	FG3002-020-621
R17	7.5 ohm, 5%, ¼ watt	1	FG3002-020-75
R51	10 ohm, 5%, ½ watt	1	FG3002-030-10
R44	402 ohm, 1%, ¼ watt	1	FG3002-050-23
R43	5.23K, 1%, ¼ watt	1	FG3002-050-523
R42	8.06K, 1%, ¼ watt	1	FG3002-050-80
R06	100 ohm, 0.5%, ¼ watt	1	FG3002-050-23
R30	100K, 0.5%, ¼ watt	1	FG3002-050-10
R05, 55	898 ohm, 0.5%, ¼ watt	2	FG3002-050-220
R04, 31	8.98K, 0.5%, ¼ watt	2	FG3002-050-212
R03	89.8K, 0.5%, ¼ watt	1	FG3002-050-213
R02	898K, 0.5%, ¼ watt	1	FG3002-050-214
R07	89.8 ohm, 0.5%, ¼ watt	1	FG3002-050-238
R08	8.98 ohm, 0.5%, ¼ watt	1	FG3002-050-200
R09	1 ohm, 0.5%, ½ watt	1	FG3002-050-241
R01	8.98 Megohm, 0.5%	1	FG3002-040-123
R20	1.5K, 500V thermistor	1	FG3002-080-105
R45	200 ohm pot, top adj.	1	FG3002-090-120
R29	5K pot, top adj.	1	FG3002-090-102
R35	1 Megohm, adjustable	1	FG3002-090-200

Ref. Desio.	Description	Quantity	Part Number
C02, 05, 06, 12, 13	22μF, 16V, aluminum	5	FG3002-160-101
C08	.022μF, 10%, 50V, mylar	1	FG3002-130-101
C04, 07, 09-11	.22μF, 10%, 50V, poly	5	FG3002-130-108
C03	.01μF, 20%, 16V, ceramic	1	FG3002-100-111
C14	100pF, 5%, 50V, ceramic	1	FG3002-100-105
C01	20pF, 5%, 50V, ceramic	1	FG3002-100-106
D01	1N4001 diode	1	FG3002-230-107
D02	1N4148 diode	1	FG3002-200-100
D03	5.6 volt zener diode	1	FG3002-230-101
Q02-05, 07, 08, 11	2SC1959 transistor	7	FG3002-250-108
Q01, 09, 10	PN2907A transistor	3	FG3002-250-109
Q06	2SK30A FET	1	FG3002-250-110
U04, 05	T1062 op-amp	2	FG3002-270-102
U09	MC14016 CMOS switch	1	FG3002-270-103
U08	MC14017 CMOS counter	1	FG3002-270-104
U03	MC14070 CMOS XOR gate	1	FG3002-270-105
U06, 07	MC14518 CMOS BCD counter	2	FG3002-270-106
U01	7106CPL A/D converter	1	FG3002-270-107
	9-pin conn. (F)	1	FG3002-370-270
	4-pin conn. (F)	1	FG3002-370-271
	9-pin conn. (F)	1	FG3002-370-277
	6-pin conn. (F)	1	FG3002-370-278
	15-pin conn. strip	1	FG3002-370-279
	Conductive rubber	1	FG3002-370-274
	Battery snap	1	FG3002-370-280
	LCD display	1	FG3002-390-107
	Slide switch	1	FG3002-400-100
	Fuse, 100 mA, 250V	1	FG3002-400-101
	Test leads	1	FG3002-370-100
Y01	32.768kHz crystal	1	FG3002-360-102
	Switch contact	8	FG3002-370-281
	Bottom shield	1	FG3002-450-100
	Top shield	1	FG3002-450-101
	Top case	1	FG3002-420-100

Ref. Desio.	Description	Quantity	Part Number
	Bottom case	1	FG3002-420-101
	Knob, Cap zero	1	FG3002-420-102
	Knob, function	1	FG3002-420-103
	Switch body (M)	1	FG3002-420-104
	Switch body (F)	1	FG3002-420-105
	Switch planking	1	FG3002-420-106
	Tilt bail	1	FG3002-420-107
	Holder	1	FG3002-420-108
	Battery hatch	1	FG3002-420-109
	Display cover	1	FG3002-420-110
	Window overlay	1	FG3002-420-111
	Instruction Manual	1	FG3002-940-100
	Overlay	1	FG3002-920-100

6.4 Troubleshooting Guide

In case of difficulties in operating your CAPT6 Capacitor and Parts Tester, please follow this guide to help isolate the problem:

1. Check battery, replace if necessary.
2. Check fuse, replace if necessary.
3. Review operating instructions for possible errors in operating procedure.
4. Test probes for continuity.
5. Check for oscillator signal at pin 1 of U06
   OK—proceed to #6
   Bad—check Y01, U01, U06.
6. Check and adjust calibration.
7. Check reference voltages.
8. No decimal point—check U03.
9. 'Lo Bat' indication bad—check D01, D03, U03.

Notes

MP MASTER
MA33127

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